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ABSTRACT

Production-function analysis, a correlation-based analysis, has been used for years to evaluate whether resources deposited into the educational process yielded a definitive result. For example, it has been used in several state cases as a measure of equity in educational funding. This paper is of the opinion that correlation-based analyses are not accurate reflections of the relationship between educational expenditures and student achievement and offers an alternative methodology based on t-tests and other tests of mean differences. Data from the State Departments of Education of Missouri, Ohio, Pennsylvania, Rhode Island, South Dakota, and Virginia--states that have been involved in equity lawsuits--were analyzed using both production-function analysis and t-test-based methods. The data produced by tests of means differences indicate a significant relationship between instructional expenditures and student achievement, a relationship which production-function analysis failed to show. Sixteen tables are included. (Contains 23 references.) (LMI)

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The States Where Money Has Been Shown to Make a Difference in School Achievement

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Introduction

Production function analysis of the educational process has been utilized for several years in the evaluation of whether the resources deposited into the process yielded a definitive result, and what that relationship is at the margin. Hanushek (1979, 1981, 1986) and Walberg (1982, 1984) are central proponents of this method of analysis. Monk (1992) has offered production function analyses as useful tools in the evaluation of educational funding equity, although he admits numerous shortcomings inherent in the methodology at this time. Hedges, Laine and Greenwald (1994) use meta-analysis to show that overall, the array of research on the topic suggests results contrary to the work of Hanushek and Walberg. This paper offers further support that there are significant relationships between educational expenditures and student achievement, and that correlation based analyses may not be as well suited to reflect these relationships as methods involving t-tests and other tests of mean differences.

Courts in several states have heard argument concerning school funding equity in which this alternative model has rebutted the Domesday findings of the production function methodology. In each case, this testimony was presented with specific regard to the defendant's (states) argument that money does not make a differences in educational achievement.

Production Function Methodology

Monk (1992) describes production function analysis as the relating of an input measure to an output measure using correlation or multi variate analysis (regression analysis). He reports that production function research began in education some 30 years ago and the process involves the study of relationships between purchased schooling inputs and educational outcomes. While promoting the study process, Monk admits it has finite utility in policy research because of methodological limitations. Monk points out that recent research includes more complex multi variate models which have greater potential for policy determination. However, as evidenced by Monk's recent testimony defending the State of Rhode Island against plaintiffs seeking greater equity in school funding, these refined methods have failed to prove more reliable, valid, accepted or appropriate measures of equity.

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The conceptual underpinning of production function analysis is that the inputs produce the outputs. However, both simple and multi variate models of production functions are based on correlational methods which are inadequate to deal with the concept of causation, and may not be reliable in the demonstration of association between the variables of interest.

The assumptions of correlation require normal, independent, identically distributed observations. Most obvious variables do not behave in a fashion which is conducive to linear correlation interpretations. For instance, the inherent wealth of a school district might influence the input side of resident children's production functions. Wealth is not distributed normally, so the best that could be hoped for is that the analysis correctly reflects the linear portion of associated variation, regardless of how much non-linear variation is observed in the system.

In the simple linear correlation model, a single input variable is compared with a single output variable to determine the degree with which they covary. It becomes immediately obvious that no single variable can appropriately represent either all educational inputs or all educational outputs. Results from this type of comparison may vary widely, and even when 'strong' relationships are found, the variables are so poorly specified that it becomes extremely difficult to try to sort out whether a true relationship has been found.

The multi variate model attempts to partition the explained variance in the model to reduce the chance of the results being skewed by improper variable specification. In this model a single output variable is predicted by one or more input variables and by intervening variables. Input variables are often things like teacher experience, teacher preparation, breadth of curriculum and instructional expenditures. Intervening variables are often observations such as ethnicity or other socioeconomic variables, size of school district or population density. While the intervening variables are used to control factors which may confound the true relationship between inputs and outputs, there is frequently a problem of shared variance among these variables. Each intervening variable's contribution toward the explanation may overlap with another, inflating the actual variation credited to the intervening variables, and thereby understating the variance associated with the selected input variables.

Correlation based methods comparing expenditures and achievement test performance suffer from several other problems. Often, when school districts are compared for these purposes, there are only a few dollars difference in per pupil expenditures between districts with substantially different cost structures. Unless the observations are separated by a larger amount than the measurement error, a gross underestimation of the true relationship between expenditures and achievement may occur. This is referred to as a threshold effect. Expenditure of an additional $1 may not get very far in terms of buying better test scores, but an additional $250 might.

along with the threshold effect and limitations of correlational methods, the production function methodology makes fundamental errors of assumption. Since this methodology requires inputs to equal outputs, then the dollars must translate consistently into the achievement scores. However, students are not widgets, and do not roll off the assembly line like personal computer clones. Each student has their own production function, and it may be similar to the average for the school, but it might also be considerably different.

An Alternative Methodology

There are three modifications that can be made to the production function methodology that would result in a more policy relevant analysis. To identify the effects of large versus small expenditures the research task appears to demand a comparison rather than an association. Second, perhaps the question that needs to be asked is not whether there is a consistent relationship across the entire population, but rather, for what kinds of members of the population do such effects exist within a state. A third change is to create a discrepancy in expenditures large enough to overcome differences in the purchasing power for educational services. Switching from the correlation based production function to measures of mean differences such as t-tests accomplishes all of these things. Also, since the tests of mean difference lend insight into the probability of two sub samples having been drawn from the same population, there are additional arguments that can be made for the case of equity using t-tests which cannot be made with correlation.

Finding Homogeneous Groups

In many states there are several factors that threaten the consideration of the school districts as homogeneous elements or that keep you from expecting that their spending patterns are similar. These factors can include such things as the size of districts, rural or urban, percentage of exceptional children (either gifted or at risk). In states like Montana and Missouri, size is a dimension which creates homogeneous subgroups. in Alabama, rural/urbanism is the primary dimension that identifies homogeneous subgroups. In Ohio, income levels or socioeconomic status creates like groups. Each relevant factor within a state must be given appropriate consideration.

Partitioning the Variance in Funding

In 1970 a study conducted for OPPE/BESE/USOE found that approximately 300 dollars was needed to improve elementary student's reading scores by a one-month-of-training-experience level over the course of a year. A proration of this finding suggests a disparity of 600 to 700 dollars would be needed, at a minimum, between subgroups of homogeneous districts to find a similar result (The future value of 300 dollars after 24 years at 3.5 percent monthly compounding is $694.06). Now, ranking the districts by

instructional expenditures per pupil, the top and bottom 30% are segregated as the high expenditure group and low expenditure group. The sample sizes are equal and the differences in expenditures should exceed 600 dollars. Given the satisfaction of these conditions, differences in achievement scores are likely to be found.

Results of the Alternate Methodology Using t-tests

Data from the appropriate State Departments of Missouri, Ohio, Rhode Island, Pennsylvania, Virginia and South Dakota were obtained through Education Policy Research, Inc., which participated in equity lawsuits in those states. These data include the per pupil expenditures, stand-in data for socioeconomic status, enrollment, and achievement data which were used in the preparation of the cases by both plaintiffs and defendants. A more detailed treatment is given in the first four tables to the state of Missouri, not for the sake of using Missouri's data, but rather to show the incremental effects of the methodology. The reader will note that throughout the various states portrayed on the 16 tables, the t-test methodology is better able to capture significant relationships than the production function methodology, and in cases where both methodologies find a significant relationship (at some confidence level), the t-test methodology general is capable of increasing the confidence level of the estimate over the production function methodology.

In Table 1 are shown the production function correlations for the achievement data for the school districts in Missouri. Please note that there is only one correlation, the one for tenth grade mathematics, that is large enough to be judged different from zero. Since there are twenty production functions, we can conclude that the production function shows no relationship between instructional costs and achievement in Missouri.

In Table 2 are shown the t-tests resulting from a partial application of the alternative approach which creates the funding threshold not included in the production function analyses for the twenty distributions of achievement data. The creation of the threshold results in ten of the distributions showing significant positive relationships. If one went to a confidence limit for a family of t-tests, one would still have to conclude a positive relationship between achievement and per pupil expenditures that was hidden by the production function analyses.

Application of the full alternative model involves not only the creation of the threshold, but also the elimination of outliers or of extreme scores which have an unusual relationship between instructional expenditures and achievement. Such scores come from economies of scale effects, the impounding of at-risk students, or the amassing of beyond essential wealth. In order to complete the comparison, production function analyses were performed on the twenty distributions after the outliers had been eliminated. In Table 3 are reported the results of these production function

analyses. Significant non-zero correlations are found for four of the twenty coefficients: fourth grade reading, eighth grade reading and social studies, and ninth grade mathematics. The significant correlation for tenth grade mathematics was lost in the elimination of the outliers. Still these four non-zero correlations are not still enough to substantiate a relationship between instructional expenditures and achievement.

In Table 4 are reported the results of the full application of the model. Note that the threshold is about $620 dollars and that the number of districts has now been reduced to 331. Eight of the twenty t-tests are significant, permitting the conclusion of a clear relationship across levels. Missouri school districts can be characterized by a large number of districts with fewer than 300 students enrolled, a few extremely large districts which have a majority of high risk students and high expenditures, and a handful of rich districts that have extremely high expenditures.

A similar sequence of analyses have been performed for data obtained for the state of Ohio. The sequence is to perform production function analyses on the number of school districts in the state and to contrast the results with t-tests performed after a threshold has been created. This sequence comparing production functions with t-test contrasts are then repeated after outliers have been removed.

In Table 5 are reported the nine production function analyses for Ohio. None of the nine achievement areas show non-zero correlations. In Table 6 are reported the t-test contrasts for the same nine Ohio distributions. Three of the nine achievement areas show positive relationships after the threshold has been created. They are: sixth grade reading, sixth grade mathematics, and eighth grade mathematics. Again, the three out of nine may not be convincing enough to conclude relationships between instructional expenditures and achievement. In Tables 7 and 8 are reported the same analyses after the outliers have been removed from the achievement distributions.

The nine production functions reported in Table 7 include only one non-zero correlation, for eighth grade mathematics. From these analyses one is led to conclude no relationship between instructional expenditures and achievement in Ohio. In Table 8 five of the nine t-test contrasts show positive relationships leading to the conclusion that instructional expenditures are related to achievement, demonstrating the inefficiency and inappropriateness of production function analyses. Tables 9 through 16 depict similar trends and statistics for the states of Rhode Island, Pennsylvania, Virginia and South Dakota. Table 10, where the t-test methodology is applied to the State of Rhode Island, indicates that every relationship except one is significant at lest at the 0.10 level.

Conclusion

After reviewing these tables, the reader will likely arrive at the conclusion that money is significantly related to student achievement. The t-test methodology demonstrates a superior ability to identify relationships between programs, funding and student achievement than can be described using production function methodologies. There are those who do not share this view, but even their number is dwindling. Bracey (1994) reports that Hanushek has now retracted his earlier statements that money does not matter to student achievement.

Table 1: Correlations Between Expenditures per Student and Student Performance on MMAT Achievement Tests

Grade	Subject Area			
	Reading	Mathematics	Science	Soc.Studies
4th (n=509)	0.050	0.073	-0.008	-0.025
6th (n=522)	-0.026	-0.044	-0.108	-0.062
8th (n=519)	-0.024	-0.019	0.027	0.012
9th (n=392)	-0.005	0.077	0.077	0.072
10th (n=433)	0.049	0.117 *	0.027	0.065

* denotes p<0.05

** denotes p<0.01

Table 2: Contrasts of High and Low Funded Districts - Missouri
Per Pupil Expenditures $2056.79 to $1248.48 (n=514)

Subject	Group	Mean	Stan.Dev.	n	t	Sign.
Fourth Grade Reading	High	315.80	26.36	154	2.240	0.05
	Low	309.32	23.92	154		
Fourth Grade Mathematics	High	312.67	34.61	154	1.664	0.05
	Low	306.87	25.32	154		
Fourth Grade Science	High	330.33	41.01	154	0.201	ns
	Low	329.48	32.05	154		
Fourth Grade Soc.Studies	High	335.52	37.92	154	0.333	ns
	Low	334.14	34.04	154		
Sixth Grade Reading	High	309.83	23.56	158	0.811	ns
	Low	307.47	23.56	158		
Sixth Grade Mathematics	High	360.12	42.67	158	0.298	ns
	Low	358.82	34.39	158		
Sixth Grade Science	High	349.00	41.80	158	-0.942	ns
	Low	353.27	38.28	158		
Sixth Grade Soc.Studies	High	323.94	32.54	158	0.175	ns
	Low	323.31	31.19	158		
Eighth Grade Reading	High	325.98	24.26	156	1.088	ns
	Low	322.97	24.30	156		
Eighth Grade Mathematics	High	341.92	40.07	156	1.318	0.10
	Low	336.19	36.16	156		

Table 2 continued,

	Group	Mean	St. Dev.	n	t	Sign.
Eighth Grade Science	High	365.41	44.25	156	0.955	ns
	Low	360.96	37.45	156		
Eighth Grade Soc.Studies	High	326.32	27.26	156	1.764	0.05
	Low	321.08	24.84	156		
Ninth Grade Reading	High	294.13	22.59	131	2.198	0.05
	Low	287.63	18.94	131		
Ninth Grade Mathematics	High	312.61	35.81	131	2.961	0.01
	Low	299.64	23.17	131		
Ninth Grade Science	High	367.99	37.51	131	2.143	0.05
	Low	357.41	31.98	131		
Ninth Grade Soc.Studies	High	316.89	24.85	131	2.295	0.05
	Low	309.49	20.34	131		
Tenth Grade Reading	High	311.82	24.52	144	1.693	0.05
	Low	306.89	18.36	144		
Tenth Grade Mathematics	High	339.80	32.30	144	2.525	0.01
	Low	330.52	20.31	144		
Tenth Grade Science	High	347.97	29.23	144	1.180	ns
	Low	343.79	23.54	144		
Tenth Grade Soc.Studies	High	309.53	24.59	144	1.196	ns
	Low	306.03	18.47	144		

Table 3: Correlations Between Expenditures per Student and Student Performance on MMAT Achievement Tests

Grade	Subject Area			
	Reading	Mathematics	Science	Soc.Studies
4th (n=329)	0.142**	0.107	0.019	0.096
6th (n=329)	0.048	-0.026	-0.052	0.015
8th (n=329)	0.132*	0.066	0.078	0.121*
9th (n=268)	0.063	0.146**	0.055	0.080
10th (n=318)	0.023	0.052	-0.029	0.023

* denotes p<0.05
** denotes p<0.01

Table 4: Contrasts of High and Low Funded Districts - Missouri| Per Pupil Expenditures $1906.43 to $1284.22 (n=331)

Subject	Group	Mean	Stan.Dev.	n	t	Sign.
Fourth Grade Reading	High	321.17	23.21	99	3.451	0.01
	Low	310.44	19.20	99		
Fourth Grade Mathematics	High	317.13	24.14	99	3.012	0.05
	Low	307.06	21.26	99		
Fourth Grade Science	High	336.67	28.91	99	0.914	ns
	Low	332.89	27.15	99		
Fourth Grade Soc.Studies	High	345.71	27.57	99	2.764	0.05
	Low	334.78	26.05	99		

Table 4 continued,

Subject	Group	Mean	Stan.Dev.	n	t	Sign.
Sixth Grade Reading	High	312.33	20.66	99	1.921	ns
	Low	306.98	18.16	99		
Sixth Grade Mathematics	High	363.47	34.6	99	1.020	ns
	Low	358.70	30.54	99		
Sixth Grade Science	High	358.25	36.77	99	0.748	ns
	Low	354.46	34.01	99		
Sixth Grade Soc.Studies	High	327.97	26.53	99	1.472	ns
	Low	322.62	24.13	99		
Eighth Grade Reading	High	327.68	16.69	99	3.280	0.05
	Low	319.13	17.67	99		
Eighth Grade Mathematics	High	344.05	34.44	99	2.338	ns
	Low	333.20	30.18	99		
Eighth Grade Science	High	371.37	34.25	99	2.544	0.10
	Low	359.66	32.64	99		
Eighth Grade Soc.Studies	High	329.59	21.13	99	3.419	0.01
	Low	319.24	21.13	99		
Ninth Grade Reading	High	293.30	17.25	81	2.848	0.05
	Low	288.01	18.21	81		
Ninth Grade Mathematics	High	311.95	26.83	81	2.808	0.05
	Low	300.58	23.32	81		

Table 4 continued,

Subject	Group	Mean	Stan.Dev.	n	t	Sign.
Ninth Grade Science	High	366.42	28.53	81	2.014	ns
	Low	357.01	29.6	81		
Ninth Grade Soc.Studies	High	316.33	19.74	81	2.275	ns
	Low	309.24	19.15	81		
Tenth Grade Reading	High	311.73	17.13	93	1.263	ns
	Low	308.55	17.09	93		
Tenth Grade Mathematics	High	338.46	21.65	93	2.089	ns
	Low	332.03	19.87	93		
Tenth Grade Science	High	347.79	19.55	93	0.755	ns
	Low	345.40	23.34	93		
Tenth Grade Soc.Studies	High	308.67	17.31	93	0.689	ns
	Low	306.85	18.53	93		

Table 5: Correlations Between Instructional Expenditures and Selected Variables in Ohio Database

Selected Variables	District Instructional Expenditures per Student	
4th Grade Reading	-0.012	n = 608
4th Grade Language Arts	-0.065	n = 608
4th Grade Mathematics	-0.024	n = 608
6th Grade Reading	0.008	n = 608
6th Grade Language Arts	-0.019	n = 608
6th Grade Mathematics	-0.006	n = 608
8th Grade Reading	0.004	n = 608
8th Grade Language Arts	-0.028	n = 608
8th Grade Mathematics	-0.002	n = 608

** denotes $p<0.01$

* denotes $p<0.05$

Table 6: Contrasts (t-tests) of School District Expenditures on Achievement Scores in Ohio.
Upper Group $2442.62 and Lower Group $1578.16 (n=608)

Subject	Group	Mean	St Dev	n	t	Sign
4th Reading	high	54.95	5.93	183	1.133	ns
	low	54.27	5.45	183		
6th Reading	high	54.27	5.74	183	1.514	0.10
	low	53.34	5.90	183		
8th Reading	high	54.79	5.41	183	1.264	ns
	low	54.07	5.36	183		
4th Language	high	53.821	6.79	183	0.041	ns
	low	53.18	6.29	183		
6th Language	high	53.05	6.21	183	1.057	ns
	low	52.36	6.30	183		
8th Language	high	53.73	6.25	183	0.648	ns
	low	53.30	6.23	183		
4th Mathematics	high	52.73	7.50	183	1.081	ns
	low	51.88	7.41	183		
6th Mathematics	high	53.46	7.03	183	1.740	0.05
	low	52.15	7.29	183		
8th Mathematics	high	53.70	7.31	183	1.712	0.05
	low	52.43	6.89	183		

Table 7: Correlations Between Instructional Expenditures and Selected Variables in Ohio Database

Selected Variables	District Instructional Expenditures per Student	
4th Grade Reading	0.053	n = 458
4th Grade Language Arts	0.034	n = 458
4th Grade Mathematics	0.071	n = 458
6th Grade Reading	0.055	n = 458
6th Grade Language Arts	0.037	n = 458
6th Grade Mathematics	0.074	n = 458
8th Grade Reading	0.072	n = 458
8th Grade Language Arts	0.024	n = 458
8th Grade Mathematics	0.091*	n = 458

** denotes $p<0.01$
* denotes $p<0.05$

Table 8: Contrasts (t-tests) of School District Expenditures on Achievement Scores in Ohio.
Per Pupil Expenditures $2227.07 to $1601.62 (n=458)

Subject	Group	Mean	St Dev	n	t	Sign
4th Reading	high	54.84	6.19	138	1.117	ns
	low	54.05	5.46	138		
6th Reading	high	54.11	5.97	138	1.398	0.10
	low	53.10	5.94	138		
8th Reading	high	54.77	5.64	138	1.303	0.10
	low	53.91	5.36	138		
4th Language	high	53.721	7.04	138	0.994	ns
	low	52.93	6.02	138		
6th Language	high	52.96	6.38	138	1.163	ns
	low	52.07	6.17	138		
8th Language	high	53.53	6.31	138	0.412	ns
	low	53.22	6.04	138		
4th Mathematics	high	53.28	7.89	138	2.085	0.05
	low	51.43	6.73	138		
6th Mathematics	high	53.61	7.42	138	2.242	0.05
	low	51.64	7.02	138		
8th Mathematics	high	53.55	7.72	138	1.685	0.05
	low	52.07	6.72	138		

Table 9: Correlations of Instructional Expenditures with Selected School Criteria for Rhode Island (5-10-93)

Criterion	Correlation	Significance
Reading, 3	0.236	ns
Reading, 6	0.491	0.01
Reading, 8	0.742	0.01
Reading, 10	0.377	0.05
Mathematics, 3	0.224	ns
Mathematics, 6	0.423	0.05
Mathematics, 8	0.659	0.01
Mathematics, 10	0.062	ns
Language, 3	0.216	ns
Language, 6	0.372	0.05
Language, 8	0.634	0.01
Language, 10	0.012	ns
Total, 3	0.241	ns
Total, 6	0.465	0.01
Total, 8	0.715	0.01
Total, 10	0.148	ns
Fitness, 3	-0.042	ns
Fitness, 6	0.065	ns
Fitness, 8	0.256	ns
Fitness, 10	0.005	ns
Writing, 3	0.289	0.10
Writing, 6	0.122	ns
Health, 3	0.595	0.01
Health, 6	0.594	0.01
Health, 8	0.696	0.01
Health, 10	0.673	0.01
SAT Mathematics, All Students	0.229	ns
SAT Mathematics, College Bd.	0.128	ns
SAT Verbal, All Students	0.387	0.05
SAT Verbal, College Bd.	0.287	ns
Graduation Rate	0.548	0.01
Dropout Rate	-0.537	0.01
Attendance	0.298	0.10

Table 10: Comparison Between High and Low Funded Districts Using t-tests for Selected Criteria, Rhode Island
Low funded Group = $2,910.78, High Funded Group = $4,361.78

Criterion	High Mean	Low Mean	t	df	Sig.
Reading, 3	71.75	60.78	1.811	14	0.05
Reading, 6	78.11	62.56	3.694	16	0.01
Reading, 8	75.63	57.89	3.542	15	0.01
Reading, 10	67.71	54.22	2.794	14	0.01
Mathematics, 3	75.13	65.22	1.735	15	0.05
Mathematics, 6	79.44	65.11	3.682	16	0.01
Mathematics, 8	73.88	55.78	3.256	15	0.01
Mathematics, 10	64.57	54.22	1.950	14	0.05
Language, 3	70.88	62.11	1.413	15	0.10
Language, 6	74.78	62.78	3.701	16	0.01
Language, 8	69.00	55.00	3.293	15	0.01
Language, 10	56.86	49.11	1.422	14	0.10
Total, 3	75.13	63.78	1.795	15	0.05
Total, 6	79.44	64.44	3.973	16	0.01
Total, 8	74.13	56.22	3.589	15	0.01
Total, 10	64.00	53.00	2.053	15	0.05
Fitness, 3	62.38	59.78	0.792	15	ns
Fitness, 6	59.11	50.67	2.146	16	0.05
Fitness, 8	56.00	50.33	1.519	15	0.10
Fitness, 10	56.29	49.44	1.583	14	0.10
Writing, 3	7.00	6.56	1.724	15	0.10
Writing, 6	7.56	6.89	2.121	16	0.05
Health, 3	80.75	72.78	2.297	15	0.05
Health, 6	77.22	68.67	2.536	16	0.01
Health, 8	74.75	65.22	3.448	15	0.01
Health, 10	83.71	76.44	2.641	14	0.01
SAT Mathematics, All Students	484.14	433.50	3.641	13	0.01
SAT Mathematics, College Bd.	490.86	447.13	3.183	13	0.01
SAT Verbal, All Students	441.71	393.75	3.652	13	0.01
SAT Verbal, College Bd.	447.14	405.00	3.508	13	0.01
Graduation Rate	91.71	77.21	2.132	14	0.05
Dropout Rate	2.10	6.84	-2.185	14	0.05
Attendance	94.39	92.52	2.214	16	0.05

Table 11: Correlations between Instructional Expenditures and Selected Variables in Pennsylvania Database. Production Function Methodology. (1991-92)

Selected Variable	Correlation	n=
Mathematics, 3	0.257**	500
Mathematics, 5	0.202**	500
Mathematics, 8	0.127**	499
English, 3	0.233**	500
English, 5	0.199**	500
English, 8	0.189**	499

** denotes p<0.01, * denotes p<0.05

Table 12: Contrasts (t-tests) of School District Expenditure Groups on Achievement Scores in Pennsylvania (1991-92).
Expenditures: Upper Group $5040.62, Lower Group $3190.06
Enrollment: Upper Group 5148.66, Lower Group 2259.51

Subject	Group	Mean	St. Dev.	n	t	Sig.
Mathematics, 3	high	87.03	10.06	150	3.735	0.01
	low	83.21	7.36	150		
Mathematics, 5	high	88.72	10.19	150	2.868	0.01
	low	85.95	5.96	150		
Mathematics, 8	high	87.42	11.45	150	0.556	ns
	low	86.80	7.34	150		
English, 3	high	90.11	8.31	150	3.279	0.01
	low	87.43	5.52	150		
English, 5	high	85.26	10.59	150	2.012	0.05
	low	83.22	6.41	150		
English, 8	high	89.25	8.64	150	2.139	0.05
	low	87.34	6.67	150		

Table 13: Correlations Between Expenditures per Pupil and Measures of Student Achievement for Virginia, 1992

Correlate	Coefficient	df	Sig.
Verbal Ability, 1	0.225	131	0.01
Quantitative Ability, 1	0.223	131	0.01
Nonverbal Ability, 1	0.174	131	0.05
Work-Study Habits, 4	0.265	131	0.01
Work-Study Habits, 8	0.289	131	0.01
Sources of Information, 11	0.307	130	0.01
Reading, 1	0.265	131	0.01
Language, 4	0.185	131	0.05
Mathematics, 4	0.265	131	0.01
Social Studies, 4	0.203	131	0.05
Science, 4	0.233	131	0.01
Reading, 4	0.282	130	0.01
Language, 8	0.267	130	0.01
Mathematics, 8	0.279	130	0.01
Social Studies, 8	0.350	130	0.01
Science, 8	0.296	130	0.01
Reading, 8	0.292	130	0.01
Mathematics, 11	0.346	130	0.01
Written Expression, 11	0.258	130	0.01
Social Studies, 11	0.328	130	0.01
Science, 11	0.300	130	0.01
Percent Dropouts	-0.091	130	ns

Table 14: Contrasts on Achievement Scores of Lower 30% to Upper 30% School Districts Defined by Per Pupil Expenditures in Virginia. 1992.
Expenditures: Upper Group $5411.18, Lower Group $3777.53
Enrollment: Upper Group 9780, Lower Group 6006

Subject	Group	Mean	St.Dev.	n	t	Sig.
Reading, 1	high	56.63	9.18	40	2.953	0.01
	low	50.33	9.65	40		
Language, 4	high	63.10	8.39	40	2.146	0.05
	low	58.70	9.67	40		
Mathematics, 4	high	64.25	9.64	40	2.988	0.01
	low	57.42	10.51	40		
Soc. Studies, 4	high	64.40	9.61	40	2.763	0.01
	low	58.08	10.58	40		
Science, 4	high	69.75	7.57	40	3.477	0.01
	low	63.85	7.41	40		
Reading, 4	high	56.50	11.44	40	2.547	0.01
	low	50.68	8.70	40		
Language, 8	high	61.22	9.55	40	2.154	0.05
	low	56.85	8.36	40		
Mathematics, 8	high	57.08	10.93	40	2.570	0.05
	low	50.72	10.89	40		
Soc. Studies, 8	high	58.78	12.24	40	3.601	0.01
	low	49.80	9.62	40		

Table 14 continued,

Subject	Group	Mean	St.Dev.	n	t	Sig.
Science, 8	high	62.72	9.59	40	3.444	0.01
	low	55.40	9.19	40		
Reading, 8	high	56.20	8.70	40	3.714	0.01
	low	47.97	10.75	40		
Mathematics, 11	high	56.72	9.15	40	3.988	0.01
	low	47.20	11.78	40		
Written Exp., 11	high	63.10	8.75	40	2.922	0.01
	low	56.25	11.74	40		
Soc. Studies, 11	high	58.67	10.21	40	3.087	0.01
	low	51.22	11.08	40		
Science, 11	high	62.60	10.52	40	3.379	0.01
	low	54.10	11.66	40		
% Dropouts	high	3.05	1.60	40	0.595	ns
	low	3.26	1.56	40		

Table 15: Correlations Between Instructional Expenditures and Selected Variables in the South Dakota Database. 1991-92.

Correlate	Coefficient	n=
SAT Reading, 4	0.419**	165
SAT Mathematics, 4	0.404**	165
SAT Language, 4	0.402**	165
SAT Science, 4	0.395**	165
SAT Social Science, 4	0.417**	165
SAT Total, 4	0.447**	165
SAT Reading, 8	0.187*	165
SAT Mathematics, 8	0.304**	165
SAT Language, 8	0.332**	165
SAT Science, 8	0.171*	165
SAT Social Science, 8	0.219**	165
SAT Total, 8	0.280**	165
SAT Reading, 11	0.091	164
SAT Mathematics, 11	0.182*	164
SAT Language, 11	0.218**	164
SAT Science, 11	0.045	164
SAT Social Science, 11	0.076	164
SAT Total, 11	0.135*	164

** denotes p<0.01, * denotes p<0.05

Table 16: Contrasts (t-tests) of School District Expenditure Groups on Stanford Achievement Tests for South Dakota. 1991-92.
Expenditures: Upper Group $4248.97, Lower Group $2720.25
Enrollment: Upper Group 206.24, Lower Group 1309.04

Subject	Group	Mean	St.Dev.	n	t	Sig.
Reading, 4	high	64.08	12.26	50	3.108	0.01
	low	56.38	12.27	50		
Mathematics, 4	high	68.46	13.81	50	3.812	0.01
	low	58.14	12.97	50		
Language, 4	high	66.50	12.31	50	3.527	0.01
	low	57.88	11.88	50		
Science, 4	high	66.66	10.85	50	3.134	0.01
	low	59.76	10.94	50		
Soc. Science, 4	high	69.22	11.93	50	2.800	0.01
	low	62.26	12.67	50		
Total, 4	high	68.54	12.70	50	3.716	0.01
	low	59.16	12.29	50		
Reading, 8	high	58.46	11.07	50	1.522	0.10
	low	55.24	9.83	50		
Mathematics, 8	high	68.52	11.81	50	2.794	0.01
	low	61.30	13.71	50		

Table 16 continued,

Subject	Group	Mean	St.Dev.	n	t	Sig.
Language, 8	high	62.94	12.31	50	2.249	0.05
	low	57.44	11.90	50		
Science, 8	high	63.84	10.57	50	1.351	0.10
	low	60.76	11.95	50		
Soc. Science, 8	high	60.50	12.00	50	1.217	ns
	low	57.70	10.74	50		
Total, 8	high	62.44	11.29	50	2.251	0.05
	low	57.28	11.41	50		
Reading, 11	high	55.24	11.87	50	0.548	ns
	low	54.04	9.71	50		
Mathematics, 11	high	63.72	14.21	50	1.432	0.10
	low	60.06	10.88	50		
Language, 11	high	60.60	14.87	50	2.171	0.05
	low	54.80	11.34	50		
Science, 11	high	60.82	12.68	50	0.225	ns
	low	60.28	10.98	50		
Soc. Science, 11	high	59.36	14.61	50	0.493	ns
	low	58.08	10.81	50		
Total, 11	high	59.14	13.58	50	1.054	ns
	low	56.56	10.44	50		

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